

CHAPTER 5: SOUTH AFRICA'S NUCLEAR WEAPON PROGRAMME

5.1 Introduction

In the history of global efforts to limit the spread of nuclear weapons South Africa presents a unique case, but at the same time also alludes to some lessons for non-proliferation in general. As explained in Chapter 2 the nuclear standoff between the two superpowers reached a sophisticated stage in which the concept deterrence and nuclear security assurances fulfilled a significant role in limiting the spread of these weapons. The mindset for the acquisition of nuclear weapons was created by the realist paradigm which dominated strategic thought in the US and USSR. Despite the realist view supporting the maximising of power by a state, nuclear weapons did not spread as uncontrollable as predicted by some. The factors influencing nuclear proliferation-related decision making, proved to be more complex than just taking into account power maximising options. Other factors also impacted on nuclear weapon decision making. The incentives and disincentives, identified in Chapter 3, influencing the nuclear weapon decision have been classified as both international and domestic factors. These factors are either of a security or political nature. Non-security incentives for non-proliferation and specifically the non-proliferation norm, have developed since the first use of a nuclear weapon and have proved to be an evolving factor in influencing nuclear weapon decision making. As discussed in Chapter 4, the non-proliferation norm only became a factor influencing state behaviour since the NPT came into force in 1970. This norm, however, failed in preventing nuclear proliferation in states faced by significant regional political and security dilemmas.¹

The South African decision to develop a nuclear weapon capability must be seen in the context of the global political and security situation, especially the dominance of the Cold War influences on security perceptions. At the same time domestic issues, but specifically technological momentum and the perception of the decision makers regarding the threats facing South Africa, influenced the nuclear weapon decision. The influence of the scientific community and the initial successes from their earlier work on a “peaceful” nuclear device were compelling in creating a capability that was hard to ignore by the decision makers. In this chapter it will be explained that realist views of the threats being faced by South Africa were prominent in the South African decision makers’ world view since the middle

seventies to middle eighties. This was closely related to the views held by the government of the then strategic situation impacting on South Africa's international security standing. Although this decision was taken in the context of this South African realist international paradigm, fairly unique domestic factors also played a role in the South African case. During the middle seventies the global non-proliferation norm was developed, but was far from being universally accepted. It is argued that a Cold War related threat perception and South Africa's domestic apartheid policies were factors influencing the decision making regarding the nuclear weapon programme in South Africa. It will also be illustrated that the South African nuclear development programme had a bureaucratic driven momentum which functioned within the context of international and domestic threat perceptions.

The South African case also seems unique in that two distinct decision making processes for a nuclear capability could be identified. In contrast to Israel and China, information on South Africa's first nuclear explosive programme indicates that the initial purpose of a nuclear device was primary for "peaceful purposes". A nuclear device was conceived as having applications in South Africa's mining industry. A decision was only taken in 1977 to develop a military weapon based on the civilian programme. The civilian programme, however, provided the basis on which this programme could later be converted to a military programme.

The decision to rollback the weapon programme was taken at the end of the Cold War and thus the end of the period during which the realist paradigm was dominant in South African government circles. While the global non-proliferation norm was more developed at this stage, it is argued that security and domestic factors still could be regarded as prominent motivators for this decision, especially future economic opportunities made possible by a changing domestic political situation. During this period the probable transformation of South Africa into a democracy was also foreseen by some within the ruling elite. The decision makers took note of the perquisites of international acceptance on the nuclear field by subscribing to the global norm (by becoming a State Party to the NPT).

The intense secrecy surrounding the nuclear weapon programme as well as a policy decision to destroy all information regarding the programme, impacted negatively on researching the rationale for the South African nuclear explosive programme and the nuclear rollback. Because of the sensitive nature of these

programmes and the limited number of persons involved in the programmes, primary sources conclusively explaining the motivations of the decision maker in this regard could not be identified. This Chapter is thus primarily based on published research (local and foreign), produced after the official acknowledgement by the government regarding the former nuclear weapon capability in 1993, as well as interviews with persons involved or knowledgeable about the programme and unpublished documents written by such persons.

At first, a brief history of the South African nuclear programme is provided with the purpose to sketch the chronology of the rise and demise of the South African nuclear weapon programme. The history of subsequent strong commitment of South Africa to the non-proliferation norm is included to highlight the fact that although the norm was not a significant factor during the Cold War era in South African nuclear decision making, this changed after the Cold War era. The incentives and disincentives influencing these decisions are also more closely examined. Account is taken of the threat perception that dominated security thought in South Africa during this period. Although elements of this threat perception were part of the relevant South African governments' world view, some significant changes occurred during the leadership periods of the relevant South African leaders at the time of the nuclear weapon decision making. Despite the fact that the threat perception provided the milieu in which these decision making processes took place, domestic bureaucratic and scientific pressure proved to be decisive in the South African case. While a lack of documentary evidence directly links these threat perceptions to formal decision making regarding the nuclear weapon capability, these decisions occurred during the times of specific leaders; the "peaceful" nuclear device (BJ Voster era), military nuclear device (PW Botha era - decision taken at end of Voster era) and rollback (FW de Klerk era). The aim of this South African study is to identify and analyse the most prominent incentives and disincentives that resulted in the South African nuclear weapon programme and its demise. This will provide some indication of implications for the global non-proliferation norm. South Africa remains the only case of a nuclear weapon capable country outside the NPT to abandon such a capability.

5.2 History of the South African Nuclear Weapon Programme .

5.2.1 Early Establishment of the South African Uranium Mining and Nuclear Industry

Towards the end of the Second World War, General Jan Smuts, the then Prime Minister of South Africa, received a top secret telegram from the British Chancellor of the Exchequer requesting him to investigate the possible existence of uranium deposits in South Africa. The uranium was needed in the Manhattan Programme to manufacture nuclear weapons for the Allied Forces. Local investigations, in conjunction with the mining industry, discovered that uranium was found in most Witwatersrand gold mines and could be extracted as a byproduct of the gold mining process.²

This led to the first stage of the development of the South African nuclear industry in the late 1940s, focussed on the extraction of uranium ore for export. After the Second World War it was anticipated that there would be a boom in world demand for uranium because of perceived potential international growth of the nuclear industry. In the light of these perceived economic spinoffs the South African government established the South African Atomic Energy Board (AEB) in 1948 with the aim to conduct nuclear research and development activities.³

The US and UK regarded South Africa as an important uranium supplier, seeing that it was estimated to have as much as 25 percent of the then non-communist world's total uranium reserves. These countries also invested in uranium-processing facilities in South Africa. The first full-scale uranium extraction plant started operating at the West Rand Consolidated Mine in 1952. Between 1953 and 1971 the US imported more than 40 000 tons of South African uranium oxide, valued at \$450 million.⁴

In return for the export of uranium, South Africa received nuclear related assistance from the US. Over ninety South African scientists and technicians went for training at US nuclear research installations and began South Africa's nuclear research and development programme.⁵ South Africa also initiated a nuclear research and development programme at the Witwatersrand University and became a charter member of the International Atomic Energy Agency (IAEA).⁶ Under the "Atoms for Peace" programme, the US and South Africa signed a 50-year agreement for nuclear co-operation in 1957.⁷ In terms of this agreement South Africa acquired the SAFARI-1 (South African Fundamental Atomic

Research Installation) reactor and highly-enriched fuel which was to be delivered at intervals.⁸ Allis Chalmers Corporation of the US supplied this research reactor which went critical in 1964 and is located at the National Nuclear Research Centre at Pelindaba, near Pretoria. The SAFARI-1 uses 90 per cent-enriched uranium fuel. This reactor has been under IAEA safeguards since it went critical and played no direct role in South Africa's subsequent nuclear weapon programme.⁹

The abundance of uranium, extensive development of the infrastructure to mine and extract uranium as well as the foreign cooperation with especially the US, laid the foundation for future military related nuclear developments. At that stage the only focus was on the peaceful application of nuclear energy with no indication that the government or the nuclear industry had any interest in a nuclear explosive capability. The initial development of the nuclear industry was driven largely by the efforts and enthusiasm of Dr Abraham Johannes Andries (Ampie) Roux. In the decade from 1962 to the middle sixties, he was able to create an incumbent industry which was technological capable of launching the subsequent nuclear explosive programme.

5.2.2 Start of Nuclear Explosives Programme

The AEB launched a research and development programme for the processing of natural uranium in 1959.¹⁰ The Cabinet also approved the national nuclear research programme in 1961.¹¹ Apart from basic nuclear research, the AEB focussed on the development of an indigenous natural uranium power reactor concept (Pelinduna) and a process for enriching uranium, which had the potential of adding significant value to South Africa's uranium exports. Due to the early success with the enrichment programme and because of resource constraints, the work on the Pelinduna reactor concept was stopped in 1967.¹²

The focus of the AEB's activities shifted to the enrichment programme. After the cancellation of the reactor programme some of the scientists working on this programme could not be accommodated in other AEB activities. Possible alternative nuclear research programmes applicable to the enrichment of uranium were subsequently investigated by an internal committee. The concept of a "peaceful nuclear explosive" was deemed to be a practical programme for the AEB by this committee. This

recommendation was accepted by the AEB in 1969.¹³

In the 1960s the concept of civilian uses for nuclear explosions was popular in the US. The US was promoting its Plowshares Peaceful Nuclear Explosion (PNE) Programme and had been conducting conferences on this issue.¹⁴ An AEB personnel member even participated in one of these conferences where he presented a paper identifying areas in South Africa where a nuclear explosive device could be used for mining purposes.¹⁵

The decision to recommend the development for a PNE was apparently taken without considering some fundamental issues relevant to such a major undertaking. No extensive cost or exact implication analysis was conducted during the investigation into the study project on the PNE. Consequently nobody (at least not those persons directly involved in the programme) was sure exactly where and how such a device could be used in the future. This will be explained later in terms of the “scientific culture” that was dominant within the AEB at that stage.¹⁶

After further encouraging laboratory results were achieved in 1969 with an indigenous uranium enrichment process based on a stationary wall vortex tube, final governmental approval was given for the further development of the process on an industrial scale and the construction of a pilot plant to demonstrate the process.¹⁷ In 1970, the then Prime Minister Voster, made a statement in Parliament in which he claimed that South African scientists had developed a new and unique method of enriching uranium, on the basis of which a pilot plant was built and a commercial-scale plant comparable with those operating in the Western World could be envisaged. An assurance was given that South Africa’s research into uranium enrichment was “directed entirely towards peaceful purposes”, and offered to collaborate in the exploitation of the new process with any non-communist country in order to promote the peaceful applications of nuclear energy.¹⁸ The Uranium Enrichment Corporation (UCOR) was established in November 1970 to coordinate the development of an enrichment process.

The construction of the Pilot Enrichment Plant (the Y-Plant), commenced in 1971.¹⁹ In March 1971 the then South African Minister of Mines, Carl De Wet, approved the AEB’s proposals to do “preliminary investigations” into producing PNEs.²⁰ The AEB started with theoretical investigations and

literature searches on the feasibility of both implosion and gun-type nuclear devices. The AEC later gave priority to work on the mechanical and pyrotechnical aspects of gun-type designs over work on an implosion design. The gun-type design probably gained favour since it satisfied safety concerns, contained no plutonium and could be stored in sections for added safety and security.²¹ At this stage the isolation of South Africa on the technological and economical terrains was only beginning and some international scientific and technological cooperation was still possible. Because of the fear that work on a nuclear device might be misconstrued as a military programme, it was decided from the start to keep the programme secret. The code name of the programme was VP for “vreedsame plofstof” (peaceful explosive).²²

Because the AEB lacked adequate facilities at Pelindaba, a small team of AEB personnel worked under tight security at a propulsion laboratory at a Somchem facility in Somerset West in the Cape Province in 1972 and 1973. At Somchem, AEB personnel worked on the mechanical and pyrotechnic subsystems for a gun-type device. The team designed a scale model that, with a projectile constructed of non-nuclear material, was tested at Somchem in May 1974.²³ The progress led to a decision by the AEB that a nuclear explosive programme was viable. In early 1974, a report was prepared that concluded that the development of a nuclear explosive device for peaceful use was feasible.²⁴ The same year Prime Minister, B.J. Voster gave approval for the production of a limited nuclear explosives capability as well as the establishment of an underground test range.²⁵ In 1974, the vice-president of the AEB, Dr L. Alberts, said that South African science and technology had “advanced sufficiently” for South Africa to produce a nuclear device if necessary. He stressed, however, that the AEB’s policy was controlled by the government, which had laid down that South Africa’s nuclear knowledge would be used for peaceful purposes only.²⁶

If at that stage the national leadership foresaw the possible military application of such a device, it was not communicated to persons involved in the programme. Although there were some vague references to the possible military application in the press, no specific government view of any non-peaceful uses of nuclear energy were made public at that stage.²⁷ No primary records confirming a military purpose for the developing nuclear industry could be identified. The initial device developed did not meet weaponisation standards (in terms of weight and deliverability). The device was bulky, weighed nearly

four tons and was connected by way of cables to testing and triggering equipment.²⁸ The main focus at this stage of the programme was to build a working nuclear explosive device. International sanctions against South Africa increased in the 1970s, and South Africa's nuclear programme was one of the first targets of these sanctions. In 1975 the US suspended additional shipments of HEU to the SAFARI reactor.²⁹ During that year work on the Kalahari nuclear weapon test site was also started.³⁰

From 1975 to 1978, the AEB developed internal ballistic and neutronic computer programmes, conducted experiments to determine properties of the materials in the devices, designed and constructed a critical facility in Building 5000 at Pelindaba, and experimented with propellants for a gun-type device.³¹ While the first of the enrichment stages of the Pilot Enrichment Plant (Y Plant) were commissioned by the end of 1974 the full cascaded operation of the plant only commenced in March 1977. Due to the long equilibrium time of the plant - the time necessary to establish the full gradient - the first HEU was only withdrawn from the plant in January 1978.³² However, a small amount (about 3 kg) of UF₆ (34,6% enriched) was withdrawn from the plant towards the end of 1977 and transferred to the AEB.³³

The success and breakthroughs on the enrichment technology created a momentum in nuclear research which made it possible for the AEB to make significant progress in developing a concept nuclear explosive device. Such an device was perceived as being useful for mining and other industrial purposes. As progress was made with the development work, the growing opposition from the industrialised world against so-called peaceful nuclear devises did not deter the government or the development team. This growing opposition was, however, pushed to the forefront by the international reaction following the discovery of the intended testing of the device in 1977. The military interest in the strategic potential of this programme, however, only started tentatively a few years before 1977. According to most sources the final decision to develop a military deterrent was only taken after the 1977 incident.

5.2.3 From Explosive Device to Nuclear Weapon

The AEB decision to identify and develop a nuclear explosive testing area led to the first contacts between the programme management and the South African Defence Force (SADF). The AEB needed assistance not only to develop such a facility but also to manage the security and provide a plausible cover story. The AEB started interacting with the SADF in 1973/74 for these purposes. The SADF purchased the area in the Northern Cape and proclaimed it as a military exercise terrain. Two holes were also sunk for future nuclear testing. Although some personnel at the SADF had knowledge of the nuclear device programme at that stage, no approaches were made by the SADF with the aim to discuss the possible military application of such a nuclear device.³⁴

The first military interest in the nuclear weapon programme was identified in 1976 when it became known that the SADF and specifically military intelligence was busy with “operational research” (to apply mathematical reasoning to functional problems) on the issue of weapon systems which could be armed with a nuclear warhead. At that stage the study was conducted by two persons and was theoretical in nature. Some contact was made with the AEB nuclear device team with the aim to ascertain the weight of a nuclear device. Seeing that the AEB scientist worked with the concept of a peaceful nuclear device (for which weight was not a factor) they were not able to assist the researchers with precise information and could only provide an estimate.³⁵

Pressure on the “peaceful nature” of the nuclear programme continued to build up. By 1977 the international climate had changed significantly concerning the concept of peaceful nuclear explosives. The US Ploughshares programme was stopped and the negative perception was strengthened by opposition that built up against the 1974 nuclear test by India. In 1977 the Carter Administration in the US also decided to suspend the US long term contract to supply low enriched uranium (LEU) unless South Africa signed the NPT. That contract provided for the supply of LEU for two nuclear power reactors under construction at Koeberg, near Cape Town.³⁶ At first the muted international reaction against the Indian test, strengthened the resolve of the South African nuclear device programme. It was argued that the reaction was not that severe and in any case “South Africa could be regarded as not harbouring any military objectives” with its programme.³⁷

When the first test device has been completed by the middle of 1977, there was not sufficient HEU

available for an underground test. It was nevertheless decided to proceed with a “cold test” (without uranium 235) at the Kalahari underground test site (Vastrap) to test the logistics, diagnostic and data acquisition systems.³⁸ On 30 July 1977 a USSR satellite passing over South Africa identified the distinctive configuration of the nuclear test site at Vastrap. The USSR alerted the US that South Africa was preparing to conduct a nuclear test. After confirming the information the US and other industrialised states pressurised South Africa not to continue with the test.³⁹ In response to this, the South African government decided to abandon the site in August 1977.⁴⁰

In the aftermath of the August 1977 discovery of the intention to test, and the subsequent sealing of the shafts and abandonment of the test site, the future of the nuclear explosive device programme was again reconsidered by the decision maker. Viewpoints held by people involved in the programme at that stage, included the view that it was useful technology that needed to be fully developed. At that stage it was believed by the people involved in the programme that options regarding the nuclear capability had to be kept open.⁴¹ The 1977 discovery of the intended test triggered the formal militarisation of the programme.

After the August 1977 incident Prime Minister Voster ordered the AEB to cancel the peaceful nuclear programme, to close down the test site and to develop a secret nuclear deterrent.⁴² It was communicated to the programme members that a nuclear weapon capability would be useful seeing that the military threat against South Africa was building up. This rather brief and unclear instruction caused debate within the programme. On the one hand most of the AEB employees stated that the fact that South Africa had a nuclear device was sufficient for deterrent purposes. According to these persons the development of a test device would be sufficient, and no further development of the technology would need to be undertaken. Others including a military officer (Brigadier John Huyser, SADF Chief of Staff for Planning) who had only recently become involved in the programme argued that a deterrent needed to be credible. A nuclear device would not be a deterrent if it was not weaponised and deliverable according to these individuals.⁴³

Brigadier Huyser out of his own accord decided to write a document stating the nuclear options for South Africa. In the document he identified three possible nuclear options for South Africa. According

to the first option South Africa should keep the nuclear programme secret. The existence of the programme and any nuclear weapons would be denied by the government. The nuclear capability would only be demonstrated in the case of a serious threat to South Africa. According to the second option a nuclear capability would be communicated through covert means to selected countries. Heads of state could be informed of the capability to modify foreign actions. The third option would be to openly acknowledge that South Africa has a nuclear capability. Thereby South Africa would achieve nuclear weapon status. He recommended the third option.⁴⁴ The document was signed by the then defence minister, PW Botha, in April 1978. He added the comment “authorised, but only when we are ready.”⁴⁵ After the document had been provided to the programme members it was finally clear that this was now a military programme with the aim to develop weaponised devices. The new interest in the weapon programme also commenced with the change of government. In September 1978, Prime Minister BJ Voster resigned because of the so-called information scandal. PW Botha, the new Prime Minister, had been the Defence Minister since 1966 and maintained that portfolio for two years after becoming head of government.⁴⁶

At this stage South Africa’s international nuclear isolation also increased. South Africa was prevented from fully participating in international nuclear matters at the IAEA. As the most advanced member from the African continent, South Africa was awarded an important role within the IAEA and served as a member of the Board of Governors until June 1977. Its growing nuclear weapon capability and increased international isolation, led to pressures from other African and NAM members to exclude South Africa from the activities of the IAEA. At the IAEA General Conference in New Delhi in 1979 South Africa’s credentials were rejected. The World Campaign Against Military and Nuclear Collaboration with South Africa played an important role in mobilising IAEA member states against South Africa’s membership and participation in IAEA activities. Although South Africa was prevented from participating in the 1979 conference and was not allowed to attend any of the subsequent annual conferences, it still retained full membership and some benefits from that, until the end of the apartheid system.⁴⁷

In October 1978 an Action Committee was appointed to advise the Head of Government on the production of nuclear weapons, based on the AEB’s PNE programme.⁴⁸ This Committee also referred

to as the Witvlei Committee appointed and chaired by Prime Minister PW Botha, also included the Minister of Mining (initially SP Botha, but since June 1979, FW de Klerk), Minister of Foreign Affairs (RF Botha), the Ministers of Finance and Defence, the Chairman of ARMSCOR (Cmdt Marais), Chairman of the AEB (Dr Wally Grant, later succeeded by Dr Wynand de Villiers), with the Director General of Foreign Affairs (Dr Brand Fourie) as secretary. This Committee met and made decisions whenever nuclear issues, such as South Africa's nuclear capability or the nuclear non-proliferation issues arose. At the beginning of 1978 the Witvlei Committee had to reflect on the progress and continuation of South Africa's nuclear capability.⁴⁹ The Action Committee's first proposals on a nuclear device and facilities needed were produced in July 1979.⁵⁰ The Committee decided to continue the development of the nuclear device, with the view to use it as a deterrent.⁵¹ In response to this report ARMSCOR was officially instructed to develop nuclear weapons.⁵² This change to a military programme resulted in the AEB deciding to stop managing the programme. Although ARMSCOR took over the development of nuclear weapons from the AEB, they were strongly supported by the AEB and later the Atomic Energy Corporation (AEC) with regard to neutronic design, nuclear safety and health matters as well as in the supply of HEU.⁵³ The South African nuclear weapon programme aims were subsequently identified as:

- ☐ the development and production of a number of deliverable gun-assembled devices;
- ☐ lithium-6 separation for the production of tritium for possible future use in boosted devices;
- ☐ studies of implosion and thermonuclear technology; and
- ☐ the research and development for the production and recovery of plutonium and tritium.⁵⁴

The first device (which was built during the civilian programme and completed by the middle of 1977) was a "non-deliverable demonstration device." Its purpose remained that of a demonstration device

throughout the programme and it was never converted to a deliverable device.⁵⁵

In 1978, the AEB built a smaller test device. This device was designed in such a way that, if the need arose, it could be rapidly deployed for an underground test to demonstrate South Africa's nuclear weapon capability. This second pre-production device was still not loaded with fissile material at that stage. The Y-Plant had produced its first HEU, but it was not until the second half of 1979 that the plant would produce enough for a device, about 55 kilograms of material.⁵⁶ In August 1979, operations at the Y-Plant halted when a massive chemical reaction contaminated the facility. The plant resumed limited operations eight months later, but it was not capable of producing more HEU until July 1981.⁵⁷ ARMSCOR's nuclear weapon activities were headquartered in facilities, known as the Circle, located some 15 kilometres away from the AEB's Pelindaba facilities. The Circle facilities were constructed during 1980 on the basis of designs provided by the AEC and were commissioned in May 1981.⁵⁸ The Circle facilities were managed by Kentron, an ARMSCOR subsidiary.⁵⁹ The second device, known by the code name Hobo, was only completed in December 1982.⁶⁰ In 1982, UCOR was incorporated with the AEB to form the Atomic Energy Corporation (AEC).⁶¹

The initial memorandum drafted by brigadier Huyser provided little guidance on contingencies for nuclear disclosures, threats, or use of the nuclear capability. In 1983 Andre Buys (the programme manager) initiated a working group to develop a more comprehensive nuclear strategy.⁶² The eventual strategy adopted, consisted of three gradually escalating phases based on the initial memorandum drafted by Huyser. A strategy of uncertainty characterised phase 1. This strategy was unknowingly followed from the beginning of the programme. According to it the government would neither confirm nor deny whether it possessed a nuclear weapons capability. Secrecy was of utmost importance, but the Kalahari incident for example, increased the uncertainty factor and assisted this strategy largely. Phase 2 was characterised as a covert pressure strategy. This strategy would only be considered when South Africa was faced by an overpowering military threat while the Western powers lacked will-power to get involved. South Africa would then quietly reveal its nuclear capability to leading Western governments, principally the US. The basic premise of this strategy was that the Western governments would be so disturbed at the potential use of nuclear weapons in the region, and so sensitive to the implications for the global non-proliferation norm, that these states would intervene before South Africa

was overrun. Should phase 2 also fail phase 3, an overt deterrent strategy, would be implemented. As a last resort, South Africa would reveal its nuclear arsenal, either by an official announcement or by an underground nuclear test. In order to demonstrate that the South African nuclear weapons are deliverable, an atmospheric test in the “southern oceans” (far from any human activity) was planned as the final deterrent. The strategy did not foresee the actual use of nuclear weapons against any opponent only the deterrence of potential enemies. The use of a nuclear weapon against the USSR for example, would constitute national suicide because of the USSR’s nuclear superiority.⁶³

In September 1985, President PW Botha decided to limit the scope of the weapons programme. The reason for this decision was cited as budget constraints. President PW Botha recognised that the cost of the weapons programme could escalate significantly. As the strategy specifically emphasised the deterrence role of these weapons, it would be pointless to have an offensive capability. The government limited the programme to the seven gun-type weapons, stopped all work related to plutonium devices, halted efforts to produce plutonium and tritium for weapons, and limited the production of lithium 6. Studies on implosion development and theoretical work on more advanced devices were continued.⁶⁴

The first qualified production device was only completed in August 1987. The relatively long delay between the first two pre-production models was largely due to the implementation of a rigorous engineering qualification programme directed towards safety and security under a range of postulated storage, delivery, and accident scenarios.⁶⁵ The weapons had stringent safety and reliability standards because a large portion of the programmes effort went into these aspects.⁶⁶ South Africa’s nuclear “strategy of uncertainty” was reaffirmed in the mid-1980s, and the government wanted to know how long it would take to conduct an underground test.⁶⁷ In 1987 ARMSCOR inspected the test shafts at Vastrap and a galvanised corrugated iron shed constructed over one of the two shafts.⁶⁸ In 1988, Circle was merged into new facilities known as the Advena Central Laboratories.⁶⁹

When in November 1989, the formal decision was taken by the Government to stop the production of nuclear weapons, one test device and five qualified deliverable gun-assembled devices had been completed and the HEU core and some non-nuclear components for the seventh device had been

fabricated.⁷⁰ These fairly unsophisticated gun-type devices were designed to operate without neutron initiators.⁷¹ Their explosive yield was calculated to be between 10 to 18 kilotons TNT. As no test was ever conducted, the yield was never confirmed.⁷²

Widely differing views exist on the actual cost of the nuclear weapons programme. Waldo Stumpf estimated the total cost over the lifetime of the programme at approximately R680 million.⁷³ According to David Fig the total nuclear programme from 1970 to 1995 cost South Africa approximately R 20 billion.⁷⁴ South Africa may have produced as much as 400 kg of HEU,⁷⁵ but HEU production was ceased in November 1989.⁷⁶ The Y-Plant was shut down by 1 February 1990. Apart from the nuclear weapon states, South Africa had the largest unsafeguarded uranium enrichment programme in the world at that stage.⁷⁷

The military programme was made possible by the work done during the establishment of a nuclear industry and the civilian nuclear device phases. The most difficult stages of a nuclear weapon programme namely obtaining enough fissile material and the design of a basic device had been done. Although continuing with any work on the civilian application of a nuclear explosive device proved impossible after the international reaction to the planned test, it provided the South African decision maker with a unique opportunity. Technically it was highly probable to successfully create a strategic weapon based on the work done. The incentives influencing this decision will be examined in more detail later.

5.2.4 **Termination of the Nuclear Weapon Capability**

The new State President, FW de Klerk, was informed about the status of the programme on instructions of the Witvlei Committee, after he had come to power. President de Klerk was not entirely unfamiliar with the facts as he had already been involved in the development until 1982 when he was Minister of Mining and later Mineral and Energy Affairs. He initiated a full review of the South African nuclear programme and capability.⁷⁸ An interdepartmental committee debated the issue and

suggested the termination of this programme.⁷⁹ This suggestion was accepted by an ad hoc Cabinet Committee. The Committee decided that:

- ☐ “The Republic would declare itself willing to sign the nuclear non-proliferation treaty;
- ☐ all nuclear warheads would be dismantled as soon as possible;
- ☐ nuclear material used in the warheads would be remelted and stored at the AEC;
- ☐ the more or less 250 Advena employees had to be reallocated because of security and strategic reasons;
- ☐ an amount of R52,2 million had to be voted for the dismantling process.’⁸⁰

On 26 February 1990, President de Klerk issued written instructions to terminate the nuclear weapons programme and dismantle all existing weapons. The existence of the programme was not acknowledged at that stage. The nuclear materials were melted and returned to the AEC in preparation for South Africa’s accession to the NPT.⁸¹ South Africa’s accession to the NPT on 10 July 1991 was promptly followed by the signing of a comprehensive safeguards agreement (INFCIRC/394) with the IAEA on 16 September 1991. Four days later, the IAEA General Conference adopted a resolution aimed at ensuring early implementation of the safeguards agreement and verification of the completeness of the inventory of South Africa’s nuclear installations and material.⁸² An initial inventory of nuclear materials was submitted to the IAEA on 30 October 1991.

After South Africa’s accession to the NPT in September 1991, IAEA inspectors undertook the task of verifying the declared amount of fissile material in South Africa and placing it under IAEA safeguards. This was by far the most complex effort ever undertaken by the IAEA’s Safeguards Inspectorate, since South Africa had been able to produce weapon-grade uranium for over a decade. By the end of 1992, the IAEA had inspected over 75 sites in South Africa.⁸³ Despite the transparency, IAEA verification of the completeness of South Africa’s inventory was a difficult task. The IAEA had to analyse production and material records for a period covering 20 years or more. According to Waldo Stumpf the “... verification of the HEU output of the pilot enrichment plant - through a material balance calculation based on the plant’s operations records and on the natural uranium inputs, depleted uranium

outputs an in-process gas losses - posed a particularly difficult problem.’⁸⁴ The feasibility of various commercial applications of the Advena facilities were investigated, without any success. At the end of 1991, half of Advena’s workforce, of about 230 at that stage were laid off. Less than two years later, all of Advena’s activities were terminated and remaining personnel were transferred to the adjacent ammunition manufacturing subsidiary, Pretoria Metal Pressings.⁸⁵

It was not until 24 March 1993, four years after ordering their destruction, that President FW De Klerk publicly acknowledged South Africa’s nuclear weapons programme. The government feared that revealing the existence of its nuclear arsenal earlier could have led to confrontational IAEA inspections similar to those occurring in Iraq.⁸⁶ His announcement before the Parliament followed growing international and domestic pressure to reveal the programme, which had been widely suspected in any case. De Klerk acknowledged this pressure in his speech, citing allegations in the media and by some countries that South Africa had not fully revealed its stock of HEU. These allegations were harmful to South Africa’s effort to commercialise its nuclear infrastructure and build more cooperative relations with other countries.⁸⁷

Following the announcement by the government, the IAEA sent a safeguards verification team to South Africa to ensure that all nuclear material were accounted for. By the time of the IAEA team’s visit in April 1993, the dismantling and destruction of weapons and components and the destruction of the technical documentation had been nearly completed. Dismantling records concerning the HEU components of the weapons were available and provided sufficient detail to enable the ARMSCOR data to be correlated with the corresponding data in the nuclear material accountancy records maintained by the AEC.⁸⁸

By using detailed daily operating records of the plant and supporting technical data, the IAEA recreated the daily HEU production of the Y-Plant, concluding that the “...amounts of HEU which could have been produced by the plant are consistent with the amounts declared in the initial report”.⁸⁹ In practical terms, this conclusion meant that the difference between the IAEA’s estimate of HEU production and South Africa’s declaration of HEU production was less than a significant quantity, or 25 kg of weapon-grade uranium.⁹⁰ Since the termination of South Africa’s nuclear weapon programme, the government

has committed itself to non-proliferation and subsequently implemented a non-proliferation policy.

The decision to terminate the programme was one of the early decisions during President de Klerk's term in office. A significant amount of work was undertaken to ensure that the termination of the programme was thorough and adequately safeguarded by the IAEA. This was strengthened by the later public acknowledgement of the capability and additional verification by the IAEA. During this phase it was ensured by the destruction of the capability and the implementation of national and international measures that it would be practically impossible for South Africa to restart such a programme.

In 1994, under pressure from the United States, South Africa further agreed not to build long-range missiles and to destroy the plants and equipment it was using to build large space launch vehicles. After it had demolished its key launchers and sites in 1995, South Africa was allowed to join the Missile Technology Control Regime (MTCR), a group of countries that agrees to restrict the spread of long-range missiles. The pay-off for South Africa had been access to the high-tech and military markets of the industrialised countries.⁹¹ All of these actions laid the foundation for the South African government's later strong support for the non-proliferation norm.

5.2.5 South Africa as Active Supporter of the Non-Proliferation Norm

The Non-Proliferation of Weapons of Mass Destruction Act was promulgated into law on 16 August 1993. The Act provides the necessary authority to control the trade in South African equipment, materials and technology which could be used for weapons of mass destruction applications.⁹² The non-proliferation controls also include dual-use equipment, materials and technology. The term dual-use pertains to goods and technology, which can be used for peaceful purposes as well as for the production of weapons of mass destruction. The broad approach of South Africa's non-proliferation legislation is that control will be exercised through the registration of businesses or persons and the issuing of permits with end-use restrictions. Permit applications are evaluated and issued by the South African Council for Non-Proliferation after the necessary inter-departmental investigation, consideration and recommendation.⁹³ The Non-Proliferation Act provides the necessary legal framework for implementation, within South Africa, of the non-proliferation and disarmament

obligations, which would arise out of South Africa's participation in the various conventions and non-proliferation export control groups. This policy was supported by the new democratically elected government in 1994 and later further extended.

In order to implement a clear policy on the non-proliferation of weapons of mass destruction, the South African Cabinet accepted a proposal on 31 August 1994 by the Minister of Foreign Affairs that South Africa should:

- ❑ “be an active participant in the various non-proliferation regimes and suppliers groups,
- ❑ publicly adopt positions supporting the non-proliferation of weapons of mass destruction with the goal of promoting international peace and security, and
- ❑ use its position as a member of the suppliers regimes, the Africa Group and the NAM to promote the importance of non-proliferation and to ensure that these controls do not deny developing countries access to advanced technologies required for peaceful purposes and their developmental needs.”⁹⁴

South Africa is the only country in Africa and within the NAM which is a member of, or aspires to have membership of all the non-proliferation regimes and supplier groups. As an acknowledged possessor of advanced technologies, South Africa is recognised as a fairly developed state in some fields. This allows South Africa to promote dialogue and interaction between the developed world on the one hand, while on the other, addressing the concern of the developing world that they will be unable to acquire the technology they need for their development.⁹⁵ South Africa committed itself to “...engage both the nuclear weapon states, and the threshold states to proceed with nuclear disarmament in a constructive and determined way,” according to the former Foreign Minister Alfred Nzo.⁹⁶ With the implementation of the former government's subsequent non-proliferation policies as well as the policy adopted by the new democratic government, South Africa became the first developing country to participate in most of the current nuclear related non-proliferation regimes and controls such as the Zangger Committee

(1993), NSG (1995), MTCR (1995) and the CTBT (1999). South Africa also played an active role in the negotiations of the African Nuclear Weapon Free Zone Treaty (ANWFZ), the so-called Pelindaba Treaty with other African states. The Pelindaba Treaty fulfil the function of preventing a nuclear arms race on the continent. It also aims to prevent the introduction of nuclear explosive devices into Africa by any state.⁹⁷

The legitimacy as a state that dismantled its nuclear weapons already stood South Africa in good stead by helping it to play a major role in the indefinite extension of the NPT. South Africa also continued to promote the non-proliferation norm in many multilateral fora. South Africa for example actively participated in the NPT Review and Extension Conference in New York from 17 April to 13 May 1995. South Africa took account of the fact that the draft African Nuclear Weapon Free Zone Treaty (ANWFZ) was intended to be permanent. It also took the view that the legitimate concerns about the lack of effective implementation of certain provisions of the NPT and its inherent inequalities should not be dealt with in such a way as to threaten the security that is provided by the NPT. It was also important to recognise that the NPT was the only international instrument on nuclear disarmament to which all the nuclear weapon states are party.⁹⁸

South Africa supported the indefinite extension of the treaty in principle, but proposed a mechanism to address the concerns of non-nuclear weapon states about the implementation of the treaty. This included a set of principles to be taken into account when the implementation of the treaty was reviewed, and a mechanism to strengthen the review process. These proposals provided a way to address criticisms of the treaty and to measure states' progress in their non-proliferation and disarmament obligations.⁹⁹ According to this formula two concurrent, though not legally binding, agreements were accepted as part of the further management of this treaty. The strengthening of the review process for the treaty focuses on the process of monitoring how the treaty is being observed, including reviews once a year commencing in 1997.¹⁰⁰ The indefinite extension of the NPT ensured that the treaty's key values, namely that "... the global community, are now unequivocally committed to nuclear non-proliferation, disarmament and safeguarding peaceful use", are part of the international value system.¹⁰¹ During the 2000 NPT Review Conference, South Africa again played a decisive role in negotiating a future agenda for the implementation of the Treaty but also finding a solution to a last

minute deadlock between two NPT members.¹⁰²

The fact that South Africa terminated the nuclear weapon programme provided the state with legitimacy as an significant role player on the nuclear non-proliferation terrain. This potential was used by the de Klerk government but especially by the first democratic South African government to promote the non-proliferation of weapons of mass destruction while taking into account the need for technology to promote the developing world. The principled support for non-proliferation by South Africa assisted in strengthening South Africa's legitimacy as one of the main contributors to non-proliferation during the 1990s.

5.2.6 Summary

The South African nuclear proliferation history consist of five periods, from the establishment of a nuclear infrastructure, the development of a device for "peaceful" purposes, a military deterrent, termination of the weapon programme to a active supporter of the non-proliferation norm. This represents a complete life cycle of a nuclear weapon capability and represents the ultimate aim of the non-proliferation norm for nuclear weapon states.

The history of this programme shows intense focus and progress during each of these identified periods but lacks any indication of an integrated long term view regarding the use and function of a nuclear weapon capability. The development of the South African nuclear capability was incremental, with each project built on the previous one but without practically any consideration for the long term implications thereof. Decision making in this regard seemed to be triggered by relatively short term focussed needs. The only exception seemed to be the last period in which non-proliferation promotion was identified as a more long term foreign policy aim of South Africa. This view will be further investigated when the incentives and disincentives for the South African nuclear programme are further explored in the next section.

5.3 Factors Influencing the Creation and Termination of the South African Nuclear Weapon Capability

5.3.1 National Prerequisites for Proliferation

The history of the rise and demise of the South African nuclear weapon programme and the eventual support for the non-proliferation norm provides the macro background against which the decision making influencing these changes needs to be evaluated. It does not yet explain the reasons for the start and termination of this programme. For this the national prerequisites for proliferation, the situational variables, the incentives which influenced the South African nuclear weapon decision and later decision to terminate the programme are discussed.¹⁰³

South Africa because of its mineral riches, nuclear knowhow and other natural resources possessed the economic and technological capability to develop nuclear weapons. The large uranium reserves discovered just after the Second World War, mining activity as well as the early efforts to establish a nuclear related industry through specifically the efforts of Dr Ampie Roux especially ensured that the national prerequisites for proliferation were fulfilled in South Africa. Most significant of these factors were the early success on the uranium enrichment field. Without HEU the building of any nuclear explosive device would have been impossible. Although the non-proliferation norm was still relatively undeveloped during the 1960s the export of HEU was under scrutiny at that stage, making it extremely difficult, if not impossible to obtain on the global market.

The only other viable source of fissile material for a nuclear device is plutonium. Plutonium, however, has also not traded since the beginning of the nuclear age. Plutonium can be produced in a reactor or particle accelerator.¹⁰⁴ The building of a plutonium producing reactor was also an option and was planned during the early stages of the military programme.¹⁰⁵ The plan was scrapped probably because of technical and financial constraints. South Africa's nuclear industry had no experience with regard to the building of nuclear reactors and such an endeavour would have required financial and technological input, which would have been extremely difficult if not impossible to muster by the South African government. In the three cases discussed in Chapter 3 namely China, India and Israel such plutonium producing reactors provided by foreign powers during the 1950s (when nuclear technology export control was still lax) proved vital to success of these state's nuclear weapon programmes. In the middle sixties Sweden experienced difficulties in this regard, when it was realised that no foreign

reactor could be obtained which would not be under IAEA nuclear safeguards, making the financial implications of developing an indigenous plutonium producing reactor difficult to overcome. This made the Swedish decision to abandon the nuclear weapon programme easier, seeing that a key element regarding the national prerequisites for proliferation lacked.

South Africa was the most industrialised state in Africa. South Africa also had sufficient economic resources to sustain a moderate nuclear development programme. Although the manpower and know-how base were limited, the requisite skills, managerial capability, secrecy and political will were sufficient to ensure a successful programme. The growing isolation of South Africa necessitated the effective use of dual-use technologies and innovative use of uncontrolled equipment, which limited the need for imports.¹⁰⁶ Contrary to the NWS and the cases referred to earlier, the initial nuclear device programme in South Africa ran parallel to a civilian nuclear programme. The nuclear weapon programme, however, consumed most of the nuclear development resources allocated during the eighties.

5.3.2 The Nuclear Device/Weapon Decision

In the case of South Africa the nuclear decision was twofold. Decisions were taken in the early 1970s to develop a nuclear device for “peaceful” purposes and in 1977 to establish a nuclear weapon programme based on the work that was done in the “peaceful” programme. First a provisional decision was taken in March 1971 by the Minister of Mines, for the development of a nuclear explosive device for mining purposes. Based on the progress of the initial work on the capability, the final decision to go ahead with a nuclear device “for peaceful purposes” was taken by Prime Minister BJ Voster in 1974.¹⁰⁷ Although some sources do refer to the decision to develop a nuclear device as also taking into account the deterrent value of such a capability, no evidence exists of any work on nuclear weaponisation at that point in time.¹⁰⁸ The work at that stage concentrated on the production of a nuclear device including instrumentation for a nuclear test. In contrast to a military device, a test would have been necessary for a civilian device, seeing that the yield of such a device needed to be precisely ascertained for effectiveness and safety, if used in a mining or other civil engineering role. It would, however, be highly unlikely that the future military potential of such a capability would have been

totally discounted by the decision maker at that stage.

After the plan to test the nuclear device had been abandoned in 1977 the government considered the possibility to start a nuclear weapon programme based on the expertise and developmental work done during the civilian programme. The decision to formally acquire a nuclear weapon deterrent was taken by Prime Minister BJ Voster in 1977, leading to the formal weapon programme. The decision was reportedly influenced by AEB Chairman A Roux and especially Defence Minister PW Botha.¹⁰⁹ While Voster seemed to be content to “let the program develop at its own pace,” PW Botha was “singularly fixated on getting nuclear weapons.”¹¹⁰ This second and military decision was based on a different set of incentives in which perceptions of the threat South Africa was facing, played a more significant part. The focus will now fall on the incentives that played a part in the decision making leading to the “peaceful device” and the later nuclear weapon programme. While it is known who made the decisions, the why remains more complex and need to be investigated.

5.3.3 “Peaceful” Nuclear Device Incentives

The influence of bureaucratic processes within the AEB and the ability of the AEB to get its programmes sanctioned by government were persuasive in government’s decision regarding the start of the “peaceful” nuclear device programme. The reason put forward for this programme was the perceived value such a device could have for an industrial, especially mining, purpose. This reason was not substantiated by any feasibility studies and no clear plan existed for the practical application of such a device. No evidence was found indicating that an eventual military purpose was envisaged. The government did not endeavour to control the development of the process but only authorised the recommendations as presented by the AEB.¹¹¹ This placed the AEB in a powerful position to get its programme accepted by government.

Most of the incentives for the “peaceful” nuclear device could thus be classified as domestic factors. All the domestic political incentives identified in Chapter 3, namely the role of influential individuals, economic spillover and technological momentum played a role in the decision to start the nuclear explosives programme.

The persuasiveness and ambition of Dr Ampie Roux played a significant role in the establishment of South Africa's civilian nuclear industry.¹¹² According to A.R. Newby-Fraser South Africa's nuclear achievements "... would depend in very large measures on his (Dr Roux's) judgements, the recommendations which he put forward and the manner in which the proposals were implemented."¹¹³ Without significant investment in nuclear infrastructure, nuclear knowledge development and especially nuclear research, it would have been highly problematic if not practically impossible to start a programme with the aim to create a nuclear explosive device. His involvement in nuclear research started in 1952 with his appointment as the AEB's part-time Director of Atomic Energy Research with the specific responsibility of planning and formulating the country's nuclear research and development programme.¹¹⁴ Dr Roux formulated the basic frameworks and objectives of all major nuclear research South Africa was to conduct. He subsequently became chairman of the AEB. During his period as chairman the proposal for the PNE was submitted to the government for approval. Dr Roux had the stature, contacts and persuasiveness to market the development of a nuclear explosive device on the national political level.¹¹⁵

Perceptions regarding the prestige associated with nuclear energy and possible economic spinoffs were present in the initial development of a nuclear infrastructure and even the PNE. Although the South African nuclear industry was still in its developmental phase during the 1960s, it was already regarded as a prestige programme by the South African government. The AEB was a show window for the government of the indigenous technological expertise available in South Africa. Psychologically it presented evidence of the national technological achievement of South Africa.¹¹⁶ Nuclear energy and the application of nuclear science for "peaceful purposes" seemed an area of work with great potential economic spinoffs during the late 1960s. Globally especially the developed states, invested significantly in nuclear infrastructure and research for developing applications for the nuclear industry. The early enthusiasm for nuclear energy applications such as power generation were not sustained and the status of nuclear energy has become increasingly under pressure since the late 1970s. Concerns regarding the environmental impact of nuclear energy and the rising cost, due to safeguarding and safety measures necessary for power plants, slowed the development of the industry. The 1986 Chernobyl nuclear accident in the present day Ukraine was an important watershed resulting in a serious setback for the nuclear industry in most of the industrialised countries. However, the prospect for nuclear energy as

a driver in modern technology was still high globally and in South Africa during the time of the nuclear decision. This belief was not backed up by an in-depth analysis of the real possible use of the PNE.¹¹⁷

Technological momentum also played a significant role in the establishment of a South African nuclear device programme. The success on the enrichment field was a significant determinant in the later decision to develop a nuclear device.¹¹⁸ The specific mandate of the committee investigating a new programme after the cancellation of the Pelinduna reactor programme, was to identify a possible development programme that would build on / or be compatible to the success achieved at that stage with the enrichment process.¹¹⁹ The technological programmes which could conceivably be spin-offs related to enrichment are limited. Only two possible large scale programmes would be possible. This would be the development of a reactor or a nuclear device. Seeing that the development of a reactor was cancelled in order to concentrate on the enrichment programme it would be illogical to restart a reactor development programme.¹²⁰ Following from the group's mandate, a nuclear explosive development programme was by default the only major technological nuclear applications available to focus research on.

Scientific curiosity, financed by the government without any specific objectives or aims besides enhancing South Africa's international technological standing, was part of the AEB's approach to nuclear research. During the 1960s and early 1970s the concept of "kingdom of science" overshadowed the South African scientific and especially nuclear scientific community.¹²¹ According to the "kingdom of science" philosophy subscribed to by the AEB scientists, science and technology should be developed to its fullest, then economic and other spinoffs would follow automatically. According to this philosophy science was regarded as an end and not a means to establish useful technology or industries.¹²² The view was thus held that although it was not possible at that stage for the committee and the AEB to precisely predict the full implications of such a device, it was generally believed that something useful would stem from it.¹²³ No formal feasibility, benefit and cost studies were conducted by the research group. The nuclear explosive device programme was initiated without a clear vision of the role and ultimate usefulness of such a device. It was thus initiated and managed without the project team members and even the government having a view of the consequences or use

of such an endeavour.¹²⁴

International incentives were not as significant as above-mentioned domestic incentives in the decision making regarding the peaceful nuclear device. The nature of the South African nuclear industry ensured however, that international dimension of the programme could not be ignored. The nuclear industry is a global industry and initial establishment was only possible with significant foreign interaction as mentioned earlier.

National pride and increased international status for South Africa also probably played a role in influencing the initial decision. Seeing that this programme was conducted in secret, these factors only pertained to a small group of people knowledgeable within the government, but also relevant, seeing that these individuals drove the programme. The scientific success of South Africa was seen by the government as a method to increase South Africa's international status.¹²⁵ This would be greatly enhanced if South Africa could demonstrate its technological prowess in developing a nuclear device.¹²⁶ Despite the secrecy of the nuclear explosives programme, visitors to South Africa during the 1970s reported that the AEC scientists were proud of their efforts and privately revealed their nuclear research. These visitors found the scientists to be well trained and pursuing their work with an attitude of "... wanting to show the world what South Africa can do." Many of these scientists had studied abroad during the early stage but in later years the opportunities for overseas training and contact through international conferences were severely reduced. This most likely contributed to a highly parochial world view on their part but did not appear to have impeded their technical skills in refining the gun-type design.¹²⁷

5.3.3.1 Summary

A programme to pursue the development of a nuclear device was primarily decided on within the AEB because of changing nuclear scientific priorities and the significant influence the AEB had to obtain support from the government for programmes suggested by the AEB. Part of this influence seems to be related to the personal stature, contacts and persuasiveness of Dr Roux in obtaining government approval for the programme. The nuclear device programme was a suggestion stemming from

guidelines provided to an internal AEB committee, which would be to add value to the developing enrichment programme. This choice was also formulated in the context of the “kingdom of science” in which the practical application of technology was not a factor significantly impacting on the decision making. The nuclear device programme was driven by the AEB and not by a high level government decision maker.¹²⁸ The decision to develop a nuclear device was the result of incremental initiatives and developments taken by a core group of highly motivated scientist and engineers, encouraged and directed by the leadership of the then chairman of the AEB, Dr Roux.

5.3.4 Strategic Need for Nuclear Weapons

Before the incentives for the military programme are identified and analysed, it is necessary to briefly analyse the need for a nuclear weapon for South Africa. This analysis is done with the advantage of hindsight. It is presented as an illustration of facts known at that stage, but apparently not regarded as sufficient enough to let the opportunity to obtain South Africa’s nuclear weapon capability, based on the work done up to 1977, pass.

When evaluating the strategical threat facing the South African government even in the heyday of the Cold War, the need for nuclear weapons is not self evident. International security threats especially in the Southern African context were not primarily of a military nature. The low intensity armed threat from internal opposition groupings such as the ANC and PAC did not threaten the continued existence of the then South African government at that stage. South Africa’s military establishment dwarfed those of its possible regional adversaries. Military equipment was substantial and sophisticated compared to those of these potential opponents. International restrictions have only served to stimulate the development of the domestic arms industry, which had made South Africa self-sufficient in many types of conventional weaponry. An integrated African command structure was not really feasible at any stage. Even Cuban forces, then deployed in Angola, could not present a decisive challenge, as had been proven when Cuban-South African engagements took place.¹²⁹

South Africa had few, if any, targets for nuclear weapons. The only conceivable targets for South Africa would have been staging areas for an attack in neighbouring states’, these states large population

areas or possible Soviet naval forces. The use or threat of use of nuclear weapons against above-mentioned targets would have had more disadvantages than advantages. A threat of use would have resulted in the total isolation of South Africa with devastating economic consequences. Greater USSR involvement in the region would have followed including possible extension of nuclear assurances to these countries. The use of a nuclear weapon in Southern Africa would probably have provoked overwhelming and devastating retaliation.¹³⁰

For an invasion of South Africa, especially the airlift, amphibious and engineering capabilities together with the tremendous concentration of power, needed to execute such an operation were only commanded by the US. From the standpoint of the US's political, strategic and economical interest such an enterprise did not seem logical.¹³¹ The tactical and strategic security threats South Africa faced then, were not nuclear, neither from another African state, nor from the superpowers, but rather a threat of guerrilla insurgency, whether internally or externally inspired, or through a combination of both internal and external action. It was doubtful if nuclear weapons would in any way play a role to deter such a threat.¹³² Although these arguments may seem self-evident in retrospect, it is now important to evaluate the incentives for nuclear weapons from the perspective of the South African government, within especially the security consciousness prevalent during the PW Botha government period. This perception was influenced by the realist tradition with elements of the revolutionary tradition (see for example LD Barnard's views below).

5.3.5 Situational Variables for Nuclear Weapons

Incentives and disincentives influencing the nuclear weapon decision should not be seen in isolation. As described in Chapter 3, so-called situational variables should also be taken into account. William Potter identified two sets of sufficient conditions, namely "... the balance between underlying proliferation incentives and disincentives" as well as "... the presence of one or several situational factors that might precipitate a decision to go nuclear whenever incentives outweigh constraints."¹³³ These "situational variables" or "trigger events" can also be identified in the South African case. The South African decision maker's views regarding the international and domestic situations' impact on South Africa can be regarded as situational variables in the nuclear weapon decision making. These

perceptions provided triggers for the government to follow the military route with its nuclear programme.

The first situational variable was the fact that the basic work on an explosive device was finished. This was a compelling triggering factor. In Chapter 3 the technical provisos for the manufacture of a nuclear device is discussed. During the 1960s and the 1970s there were two major impediments to nuclear proliferators namely the technical know-how for building a nuclear device and the acquisition of fissile material to manufacture such a device. Of these two factors the acquisition of fissile material is the most crucial.¹³⁴ Deficiencies in engineering skill and knowledge on the construction of a nuclear device can be overcome, if basic scientific and engineering knowledge is available in society. In South Africa with the start of a nuclear industry in the early 1960s this would not have been an insurmountable problem even if the civilian nuclear programme had not been started. The establishment of an enrichment capability (the Y-Plant) for the production of HEU for the nuclear device programme was, however, vital for the later successful production of nuclear weapons. If the work on an enrichment capability had not been done at the time the military nuclear weapon decision was taken in 1977, it would have been extremely difficult, if not impossible for South Africa to enrich or obtain the necessary HEU for a nuclear weapon programme.

Export controls had been significantly expanded after the Indian nuclear test, which would have made technology and equipment for an enrichment plant difficult to obtain. In contrast, the non-fissile parts of a nuclear device could be more easily manufactured without significant imports as the South African programme had shown. Although there were disagreements on the level of future work to be conducted, it was generally agreed by the individuals involved in the programme and the decision makers that a nuclear explosive device provided useful technology. Taking into account the perception of a growing international threat as viewed by the ruling elite there was consensus that the progress achieved up to that stage should not be abandoned.¹³⁵ This will be investigated further when discussing the nuclear weapon incentives.

The second situational variable was the strategic political milieu within which the government operated during this time. Of specific interest was the global perception within which the governing elite

formulated its security views during this period. The intellectual climate of South Africa's strategic planning and decision making in the early seventies must specifically be viewed in the context of the ruling Afrikaner-view of the world. Kenneth Adelman and Albion Knight described it as follows: "Basically, this considers the Afrikaners as a solitary Christian community increasingly pressed by a broad range of hostile external forces, forces which originate from among non-Afrikaners in the country and from outside the country. Communism is, of course, central among these forces. But Afrikaners often link Communism to elements of Western social life, which they perceive as weakening individuals and communal fibre and contributing to the international successes of Communism, materialism, secularism, and liberalism."¹³⁶ Arguments for a nuclear weapon capability such as those formulated by Dr Lukas Daniel Barnard can possibly be understood in the context of these world views. While it remains unknown to what extent these views influenced the eventual decision making regarding a nuclear weapon capability, it provided the context in which this decision was taken. This was even more the case in the context of the rise of the influence of the military-security bureaucracy under the PW Botha government.¹³⁷ These issues will be discussed in more detail when the incentives for the nuclear capability are analysed.

The third situational variable closely connected to ruling elite's world view was the domestic political transformation which took place in South Africa during 1977. The leadership in South Africa had a distinct impact on the practical manifestation of the mentioned "Afrikaner world view". The different prime ministers also brought with them changes in approaches to governing, illustrating the broader context within which the nuclear weapon decision was taken. Although each prime minister had his own operating style, each also had to function within the constraints imposed by the National Party and expectations of a ruling elite. Within those sometimes vague and sometimes rigid parameters there was considerable play. The tenures of HF Verwoerd, BJ Vorster and PW Botha reflect their personalities, their perceptions of the issues and the range of politically acceptable alternatives, and the situational variables of the day. HF Verwoerd was an overpowering figure in the National Party and once having asserted himself, was virtually authoritarian. BJ Vorster's tenure saw a more relaxed, consensus building approach to Party leadership as the Afrikaner business interest rose to prominence.¹³⁸

PW Botha contributed to the rise of the bureaucracy, the defence establishment, and the career

politicians. The military under the leadership of Minister of Defence PW Botha was highly critical of the laissez-faire practices of the Voster administration.¹³⁹ Party loyalists, especially those close to PW Botha, had moved into positions of authority.¹⁴⁰ In the process of these changes, the National Party structures had been downgraded in political significance. In the top decision making councils, party officials had been superseded by selected members of the bureaucracy.¹⁴¹ According to a declassified 1979 CIA assessment, PW Botha had: “...advocated more than any other Cabinet officer the military components of South Africa’s strategy for coping with possible external threats. He has regarded the West as unwilling to support South Africa against foreign threats that he has perceived to be growing. Moreover, he has probably sympathised with views that nuclear weapons might ultimately be needed. However, he probably has not foreseen any imminent military requirement for nuclear weapons or any political advantages to disclosing particular elements of South African nuclear weapons capabilities at this time.”¹⁴² The scope of influence of the leadership core within and managing the civilian nuclear programme and the military individuals later involved, carried significant weight during the PW Botha tenure.

5.3.6 Incentives for a Nuclear Weapon Capability

The decision to develop nuclear weapons by South Africa was motivated by international security incentives influenced by the domestic politics and security concerns. As mentioned above scientific and domestic incentives played a dominant role in the creation of the “civilian” programme, the transformation of the programme into a military one, was, however, linked to a change in the decision makers’ views of international security and political factors and the state’s response to the threats identified as facing South Africa.

As explained previously, the work done on the “civilian” programme proved that a working nuclear device could be manufactured. This changed the nature of the decision. The decision confronting the government was to continue with the militarisation of the programme or to terminate it. The South African decision makers were thus confronted with a different type of decision that had been the case

in Israel and China as referred to in Chapter 3. All of these states followed a longer period deciding on a nuclear weapon programme before starting their programmes. The events following the USSR's detection of the planned test of the South African nuclear device forced a fairly quick decision during a time of growing threat perceptions.

No information could be obtained indicating that the government conducted a systematic policy analysis coming to the conclusion that from a security perspective, South Africa needed a nuclear deterrent. The only known in-depth study of the utility of a nuclear deterrence capability was done by Dr Lukas Daniel Barnard during the time the decision was taken and shortly following it.¹⁴³ Although there is no evidence of any direct link between the decision and his arguments for such a capability, the decision makers at the very least took note of his views and probably found support for his views from PW Botha. Barnard argued that the growing isolation of states such as South Africa, Israel and Taiwan removed these states from security protection of the US. According to him these states were entitled to maintain their sovereignty to the best of their ability. He further stated: "This together with the challenges of the growing international multi-polarism, may compel these states to give serious consideration to joining the nuclear club - definitely not with a view to imperialist self-enrichment but as a deterrent to counter their status and the undermining of their sovereignty."¹⁴⁴

Barnard further believed that nuclear weapons gave such states the benefit of a deterrent strategy and allow them to preserve their sovereignty because nuclear powers were well aware of the tremendous destructive power of a single nuclear warhead in an industrial heartland. These were factors that South Africa should also consider seriously against the background of its international isolation according to him.¹⁴⁵ The maximising of military power was a logical argument within the SADF at that stage. Despite the fact that Barnard had impact on the broad strategic threat perception of the South African government, he played no direct role regarding the development of South Africa's nuclear strategy according to the drafter of that strategy.¹⁴⁶

The growing pressure on the South African political ideological system during that time created a mindset, within which it was probably easier for the decision maker to see value in a nuclear weapon deterrent, rather than to decide to dismantle the capability that had been created up to that stage and possibly lose such a capability for ever because of the level of specialisation deployed to create it. The perceptions of the international security situation prevalent in the South African decision makers mind

were strongly based on Cold War ideological views held within the government and influential government supporting individuals and entities.¹⁴⁷ The strategic threat environment as perceived by the South African government indicating an ever increasing international isolation, provided an incentive for such a capability.¹⁴⁸

5.3.6.1 International Security Incentives

The South African security situation was seriously disadvantaged by Portugal's rapid retreat from Mozambique and Angola in 1974 and 1975. In 1975 the Cuban and USSR military intervention in Angola assisted the MPLA to install a government in Angola with close relations with the Southern Africa liberation movements such as the South West African Peoples' Organisation (SWAPO) and the ANC. While South Africa regarded itself as aligned with the West against communist expansion in Southern Africa, in practise South Africa experienced the inconsequent nature of such support. The US policy on South African support to UNITA in Angola was especially relevant in this regard. In 1975 South Africa intervened militarily in Angola with covert support from the US. Meanwhile, the US Congress, in the wake of the Watergate scandal and investigations into controversial CIA activities, found out of this covert aid to South Africa and decided to stop it by passing the Clark Amendment.¹⁴⁹ According to Chester Crocker, former Assistant Secretary of State for African Affairs, the Angola incident had a traumatic effect on South Africa prompting a "... sentiment of revenge for past humiliation and an abiding suspicion of Western diplomacy."¹⁵⁰

On a global strategic level South Africa was also experiencing increasing isolation. In 1975 the UK terminated the 1955 Simon's Town Agreement for bilateral South Atlantic naval defence.¹⁵¹ With the decision by the international community to apply a complete arms embargo against South Africa in November 1977, a new situation has arisen which would challenge traditional and time-tested South African assumptions on defence policy and military doctrine.¹⁵²

These developments illustrated the changing nature of relations with Western states towards South Africa because of the growing international opposition to South Africa's racial policies. It began reaching the point in the late 1970s where no Western government could readily assure South Africa's

security, unless in the most extraordinary of times. In a US national security study of Southern Africa during this time, it was stated : “Our interests in the region are important but not vital. Our investments, primarily in South Africa, total about \$1 billion and our trade yields a highly favourable balance of payments advantage. This geographically important area has major ship repair and logistics facilities which can be useful to our defence forces. An important NASA space tracking station is located in South Africa.”¹⁵³ The political realities were such that a Western security guarantee for South Africa would be exceedingly difficult to extend and would lack sufficient credibility even if extended.¹⁵⁴

Despite this problematic nature of South Africa’s position within the broad Western security strategy, South Africa’s decision makers continued to regard South Africa as vital to the West’s “struggle” against the East. The Cape sea route was regarded as an asset to the West, which South Africa protected. South Africa as a source of strategic raw materials was also regarded of vital importance to the West.¹⁵⁵ The South African government was extremely keen for the US to formally and publicly acknowledge such a role for South Africa, pointing out that the closure of the Suez Canal had made the Cape sea route strategically more important than ever. Almost all of the West’s trade with the Far East, Australia and the Middle East, including vital oil supplies passed along this route.¹⁵⁶

When the military nuclear weapon decision was taken, the prevalent view within government, but especially the Defence Force was that the Western powers were ineffective and powerless to effectively oppose “Soviet expansionism”.¹⁵⁷ The country’s military policy was based on the assumptions that threats to South Africa were not merely local, that a bipolar conflict continued in the world, and that the USSR would continue to proclaim the need for intensifying the international class struggle between “socialism” and “capitalism”. The struggle was thus seen to be global with the threat of communist world domination, the choice was between two alternative ways of life namely the free world or the tyranny of communism.¹⁵⁸ The nuclear balance of terror had made the threat of conventional war greater rather than smaller. Peace was indivisible because every local conflict affected the global balance of power to some degree.¹⁵⁹ Although after the decision for a nuclear weapon capability, the South African government evaluated that a significant conventional threat was building up in the Southern African Region. PW Botha told Parliament in 1980 that the military equipment in neighbouring states could be “... converted almost overnight into a credible instrument of Russian aggression.”¹⁶⁰ In

1982 a Defence White Paper stated that the “...presence of Soviet armaments in the neighbouring countries of the RSA, which include heavy and advanced equipment, increases the possibility of a conventional threat to the RSA and SWA, even in the short or medium term. If the Soviet Union wishes to become involved, Soviet personnel is all that would be required.”¹⁶¹ Exaggerated fears of the USSR in the South African decision maker’s mind facilitated the nuclear weapon acquisition.¹⁶²

As illustrated above a strong threat perception was prevalent in the South African decision maker’s mind. The question which confronted the decision maker in 1977 was whether a nuclear capability could be to the advantage of the government countering these threats. The strategic value of nuclear weapons as a deterrent would, however, have been regarded as an option. The role of this deterrence was described in the South African nuclear strategy. It meant that the government of a state neither admitted nor denied that it had nuclear weapons. According to this strategy South Africa adopted a posture of nuclear ambiguity towards the outside world. It was a deterrent strategy built on uncertainty. It was better than no deterrence at all, but it was difficult to operate because it depended on bluff and counter-bluff.¹⁶³ This strategy was, however, only developed after the decision had been taken to develop a nuclear weapon capability.

At that stage the potential deterrence role of a nuclear weapon capability against the USSR backed forces in Southern Africa seemed to be a dominant incentive. Although denied by all involved it seems conceivable that its role as weapon of last resort could be taken into account at that stage as well as the potential of using it as an instrument of coercion. The official strategy developed for the weapon did not foresee the actual use of the weapon on any offensive target but only a demonstration of a deliverable weapon.

5.3.6.2 Domestic Political and Security Incentives

On the domestic front the fairly peaceful situation was scattered by the 1976 Soweto riots giving new impetus to the domestic angle of the struggle against the South African apartheid system. Within the state there were important differences of opinion on how to respond to the developing post-Soweto crisis. The government’s policy was characterised according to Mark Swilling and Mark Phillips “...

by empire building, uncoordinated departmental action, internecine conflicts within the security establishment, and the absence of an overarching strategic plan.” The military’s solution to these problems was the formulation of the “total strategy”, which was presented publicly for the first time in the 1977 Defence White Paper.¹⁶⁴ The formulation of a total strategy was to combat the so-called “total onslaught” identified by the South African government security establishment. Strategic pronouncements from that the middle seventies focussed strongly on the concept of total onslaught.¹⁶⁵ South African policy makers had taken care to spell out their views of the total onslaught. The total onslaught General Malan said, “...is an ideologically motivated struggle and the aim is the implacable and unconditional imposition of the aggressor’s will on the target state.” According to him the enemy used all means at his disposal. The onslaught was not just military it is political, diplomatic, religious, psychological, cultural, economic and social.¹⁶⁶

Strategic views in the SADF were significantly influenced on a macro level by the writings of General Andre Beaufre on what he called total strategy. According to Beaufre’s direct strategy, the military force was regarded as predominant. A total strategy “... in the direct mode is an attempt to reach a decision or to achieve deterrence either by using or threatening to use military force as the chief means of coercion.”¹⁶⁷ While the strategic perception of the government did not automatically call for nuclear weapons, the opportunity posed by the peaceful programme placed at the government’s disposal an unequalled power capability. Much of the AEB’s investment into nuclear infrastructure also made the continuing of the programme in their interest possible, ensuring continued funding of the enrichment facility.

While the SADF’s service chiefs initially questioned the military utility of nuclear weapons, the SADF might have inadvertently contributed to PW Botha’s support for a nuclear weapon capability by overstating the USSR and Cuban threat.¹⁶⁸ Ironically the then Minister of Defence, PW Botha’s and Brig Huyser’s, as an informal advisor support for nuclear weapons, did not necessarily reflect the military leadership’s views in this regard.¹⁶⁹ In any case the decision to pursue the military nuclear option was taken without consultations with the senior military leadership.¹⁷⁰ Initially the senior staff officers of the SADF were also reluctant to accept this new capability.¹⁷¹

While the practical value of a nuclear weapon was even questioned within the SADF leadership itself, the strategic paradigm encompassing views such as the total onslaught, the USSR's perceived imperial ambitions and the total strategy concept based on the views of Beaufre, all probably contributed to the frame of mind in which these weapons would be regarded as useful as a deterrent against these perceived threats. These factors assisted in the acceptance of the nuclear weapon capability by a wider scope of leadership. The decision was taken by a small group in which it seems unlikely major opposition to the continuance of the programme existed. The incremental nature of the programme again manifested with a decision taken for a nuclear weapon capability without any clear need but only a vague recollection by the Head of State that it might be useful as a deterrent. The decision was driven by the then Minister of Defence PW Botha and Brig Huyser as his personal advisor in this regard and supported by Dr Roux as the "myth-maker" with a significant vested interest in the continuance of the nuclear programme.

5.3.7 **Incentives for the Rollback of the Nuclear Weapon Capability**

The first step towards the rollback of the nuclear weapon programme were taken after a major review of the programme in 1985 when PW Botha decided to limit the nuclear stockpile to seven devices. While the international pressure to dismantle the nuclear capability did not dramatically increase in the late 1980s, the government's sensitivity to the economic and diplomatic liabilities of the programme did.¹⁷² This confirmed that the political leadership had realised that there was little use for this fairly costly instrument.¹⁷³ The South African political leadership stopped the nuclear scientists' plans to develop implosion types of weapons and limited their studies in this regard to theoretical work.¹⁷⁴ It was the first time since the programme started that the escalation of this programme was halted.

The South African nuclear rollback was decided on at the same time that the country embarked on political transformation. During the late 1980s the lessening of Cold War tensions and regional progress in solving the Namibian issue began to influence the threat perceptions in South Africa. South Africa recognised the reduced regional threat by cautiously beginning domestic political reforms, by reducing the military's domestic security role, and by reducing military spending in areas related to external operations.¹⁷⁵ At the AEC the view was held that for the nuclear industry to survive in South Africa,

the nuclear weapon programme should be terminated. The energy input for the enrichment of fuel for the Koeberg reactor was high and initial research on the development of an EMLIS enrichment project began. For this programme to be successful South Africa, however, needed to be in a position to interact with foreign entities and be able to export its enriched fuel. It became vital for the AEC to see South Africa back in the international nuclear energy and research community. This would only be possible by becoming a state party to the NPT and thus terminating the nuclear weapon programme.¹⁷⁶

At the same time role players within ARMSCOR also foresaw larger potential export opportunities for defence and defence related products, services and technologies. The satellite programme and the launch capability for satellites were regarded as possible future projects with especially significant commercial value. Again the full exploitation of these technologies would be impossible, if the nuclear weapon programme continued.¹⁷⁷

The diminishing external threat had also resulted in the SADF increasingly questioning the value of a nuclear weapon deterrent. With no direct conventional threat as was the case in Angola and Namibia, the military leadership did not regard the nuclear weapon capability as vital to the survival of South Africa.¹⁷⁸ As previously mentioned the leadership had not been consulted before the military programme was started and they did not enthusiastically support it at first. Again it seems that the military leadership had also not been consulted before the decision was taken to dismantle the capability.¹⁷⁹ The only arm of the SADF gaining a significant management role in the nuclear programme was the South African Air Force, with their task to manage the development of an effective delivery system for a nuclear weapon.¹⁸⁰

Since 1988 the USSR has been pressurising the ANC to moderate their views on the inevitability of a successful revolution in South Africa.¹⁸¹ The USSR reviewed its foreign policy towards South Africa, on the basis that the way to black majority rule should be obtained through a political settlement rather than the revolutionary overthrow of the government. USSR spokesmen during this time stressed that they did not support the destruction of Africa's largest and most successful economy.¹⁸² The USSR slowed, and eventually halted, arms shipments to Angolan and Mozambican forces and played an active role in seeking political settlements to those conflicts.¹⁸³ In 1989/90 the USSR position in Eastern

Europe collapsed. At the same time crises, chaos and change on an unprecedented scale engulfed the USSR itself.¹⁸⁴ All of this added to the diminishing of the threat perception regarding the role of the USSR in Africa in general and Southern Africa in particular.

Thus the international political and security situation changed and was changing significantly at the time FW de Klerk became president of South Africa on 14 September 1989. On 22 December 1988 an agreement was signed with Cuba and Angola making provision for the independence of Namibia and the withdrawal of 50 000 Cuban soldiers from Angola.¹⁸⁵ The late eighties thus brought major changes in international politics and the global balance of power.¹⁸⁶ The Cold War had come to an end. The prospect of moving away from confrontational relationships with the international community in general and with South Africa's neighbours in particular to one of cooperation and development was good according to President de Klerk.¹⁸⁷ He also expected that the reform which he was busy conducting would assist to end the confrontation with South Africa's neighbours and the international community. In keeping South Africa's nuclear weapon capability against that background he realised that it became an obstacle for the development of South Africa's international relations.¹⁸⁸

As previously mentioned in this chapter, widely differing views exist on the actual cost of the nuclear weapons programme, with former government officials claiming the cost to be relatively low (R 680 million) and individuals supporting the struggle estimating the cost to be much higher (R 20 billion).¹⁸⁹ The real cost probably amounted to a figure in between these mentioned amounts. The cost of the South African nuclear weapon programme was probably much lower than the case of most (if not all) other nuclear weapon states.¹⁹⁰ Despite this, it remained high taking into account the financial constraints facing South Africa during the sanctions era as well as the developmental needs facing the South African government. The cost of the nuclear weapon programme consequently also became a factor supporting the arguments for the decision to end the nuclear weapon capability.¹⁹¹ Former President de Klerk described the nuclear weapon capability as a "massive expenditure programme" inappropriate for the security needs of South Africa during the late 1980s early 1990s.¹⁹²

While the direct role of the non-proliferation norm in the decision to disband the nuclear weapon programme seemed to be limited, the changing international and national threat perceptions were

significant influencing factors. A new Head of State, who was not committed to the nuclear weapon programme as was the case with his predecessor, made the decision to abandon the nuclear weapon programme easier. As a consequence of the non-proliferation norm, both the AEC and ARMSCOR realised that South Africa's possible full return to the international nuclear and conventional arms market were firstly dependent on South Africa becoming a State Party to the NPT. The President was advised that South Africa's nuclear weapon capability posed a proliferation threat in a post Cold War era, and for this South Africa's full support for this norm was advised by the ad hoc Cabinet Committee investigating the nuclear weapon capability.¹⁹³ Although not stated by the President as an incentive for the decision, the possibility of a new black government inheriting a nuclear capability, especially if the transition process did not produce a stable political outcome can be presumed to also be an incentive influencing this decision.

5.4 Conclusion

While the South African case does illustrate and confirm the general identified international and domestic incentives for the creation of a nuclear weapon programme, it also showed that South Africa followed an incremental development path. These factors include views that a nuclear capability could be used as a deterrent, the role of the nuclear bureaucracy and strategic threat perceptions by decision makers. The political and military consequences of taking the decision to investigate the manufacture of a nuclear explosive device for mining purposes were not foreseen when the decision was taken. Subsequent developments, locally and internationally, led to a range of actions resulting in the development of a nuclear weapon deterrent.

Despite the general assumption that a matter as significant and consequently strategically important as a nuclear weapon capability would have been closely and minutely managed from the highest decision making body, many significant decisions giving the programme direction were taken on the operational level or pushed from the operational level. This may have been partly the case because of the secrecy of the programme ensuring that the decision makers were highly reliant on the insights of the operational people involved in the programme. At the same time the secrecy and limited number of people knowledgeable on this programme also prevented any significant debate on the pros and the cons of

a nuclear capability. The lack of a clear nuclear strategy and the initiating of the formulation of such a strategy by the programme management seem to suggest a lack of appreciation of the true significance of this capability by the decision maker at that stage. These factors countered the possible effect the growing international incentives could have had on preventing South Africa following the nuclear weapons route. The programme was also abandoned before the incentives against nuclear weapons were more developed. The decision makers did realise that becoming a state party to the NPT would be a necessary prerequisite for South Africa to break out of the nuclear and technological isolation imposed on South Africa.

As a former NPT “unofficial” nuclear weapon state, South Africa became relevant in asserting itself as an influential case for future non-proliferation efforts, just by successfully demonstrating that operational nuclear devices could be built despite the previous international controls on nuclear as well as dual use related material, equipment and technology. Although South Africa made sure that all weapons, hardware, software and design and manufacturing information on the weapon programme were destroyed, the expertise associated with this programme ensured that South Africa would remain a concern for some time, especially for states such as the USA, regarding global non-proliferation as a prime national policy. It is also conceivable that the change in Government in South Africa could also cause some uncertainty in especially the USA, kindling fears in some government sectors that potential instability in South Africa could cause renewed proliferation concerns.¹⁹⁴

The incremental nature of the South African programme illustrates significant limitations that exists in international efforts to combat non-proliferation. It stresses the need for regular reassessments of possible programmes of concern in threshold countries. Incentives and disincentives for nuclear weapon programmes might change significantly over time, resulting in the need to similar changes in non-proliferation responses to such factors. Taking again the South African case as example, it seems to indicate that such changes are closely associated with leadership changes and with changes in organisational management of the programme. Despite the fact that the leadership of organisational management may be the result of other factors influencing the nuclear weapon decision making process, these changes remain important indications of changes in motivational factors within the nuclear weapon programme. The high level of political will (despite a clear strategic perception of the aim of the

programme) and focussed industrial-scientific effort, as identified in the South African case, remain important for successful building of nuclear devices.

5.5 Notes

1. See also the studies in Chapter 3 on the incentives influencing the nuclear weapon programmes in Israel, India and China.
2. Von Wielligh, N. The Story of Completeness: The Untold Part, unpublished document, Pretoria, July 1999, p. 3.
3. Stumpf, W. "Birth and Death of the South African Nuclear Weapons Programme." Presentation given at the Conference "Fifty Years after Hiroshima", organised by USPID (Unione Scienziati per il Disarmo) and held in Castiglioncello, Italy, 28 September to 2 October 1995, <http://www.aec.co.za/strategy.htm>, (11 May 1999).
4. Jaster, R.S. "South Africa." in Snyder, J.C. and Wells, S.F.(Jr.)(Eds) Limiting Nuclear Proliferation, Ballinger Publishing Company, Cambridge, 1985, p. 148.
5. Horton, R.E. Out of (South) Africa: Pretoria's Nuclear Weapon Experience, US Air Force Institute of National Security Studies, Occasional Paper, August 1999, p.4, (Electronic copy).
6. Jaster, R.S. op.cit., p. 149.
7. Minty, A. S. "South Africa's Nuclear Capability: The Apartheid Bomb," in Worsley, P. and Hadjor, K.B. (Eds) On the Brink: Nuclear Proliferation and the Third World, Third World Communications, London, 1987, London, p.159.
8. Masiza, Z. "A Chronology of South Africa's Nuclear Program," The Nonproliferation Review Vol. 1, No. 1, Fall 1993, p. 35.
9. Barrie, G. "South Africa" in Goldblat, J. Non-Proliferation: the Why and the Wherefore, Taylor and Francis, London, 1985, pp. 151 - 152.
10. Newby-Fraser, A.R, Chain Reaction: Twenty Years of Nuclear Research and Development, the Atomic Energy Board, Pretoria, 1979, p. 5.
11. Von Wielligh, N. op.cit., p. 3.
12. Ibid, p 5.
13. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
14. Buys, A. "Die Ontwikkeling van Suid-Afrika se Kernwapenstrategie," unpublished and undated article, p. 1 and interview with Dr Nic von Wielligh on 25 August 1999 at Pelindaba.
15. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
16. Ibid.

17. Stumpf, W. op.cit.
18. House of Assembly, South African House of Assembly Debates, 20 July 1970, cols. 58 - 59.
19. International Atomic Energy Agency, Director General: The Denuclearization of Africa, GC(XXXVII)/1075, Attachment 1, Annex 1, 9 September 1993.
20. Masiza, Z. op.cit., p. 35.
21. Horton, R.E. op.cit., p. 4.
22. Buys, A. op.cit., p. 1.
23. Albright, D. "South Africa and the Affordable Bomb," Bulletin of the Atomic Scientists, Vol. 50, No. 4, July/August 1994, p. 5.
24. Pabian, F.V. "South Africa's Nuclear Weapon Program: Lessons for US Nonproliferation Policy," The Nonproliferation Review, Vol. 3, No. 1, Fall 1995, p. 2. (Electronic copy).
25. Van der Westhuizen, L.J. and Le Roux, J.H. ARMSCOR: The Leading Edge, Institute for Contemporary History, UOFS, unpublished book, Bloemfontein, 1997, pp. 172 - 173.
26. Rand Daily Mail, 11 July 1974.
27. See for example Beeld, 26 July 1970.
28. Interview with Prof Andre Buys on 7 June 2000 in Pretoria and interview with official, who was involved in the programme but requested anonymity on 17 Mar

29. Albright, D. South Africa's Secret Nuclear Weapons, ISIS Report, Vol. 1, No. 4, May 1994, p. 4.
30. Stumpf, W. op.cit.
31. Albright, D. op.cit., May 1994, p. 6.
32. Stumpf, op.cit.
33. Interview with official, who was involved in the programme but requested anonymity on 17 March 2000.
34. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
35. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
36. Jaster, R.S. op.cit., p. 150.
37. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
38. Interview with Dr Nic von Wielligh on 25 August 1999 at Pelindaba.
39. Reiss, M. Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities, Woodrow Wilson Center Press, Washington D.C., 1995, p. 10.
40. Stumpf, W. op.cit.
41. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
42. Liberman, P. "The Rise and Fall of the South African Bomb," International Security, Vol. 26, No. 2, Fall 2001, p. 53.
43. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
44. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
45. Originally in Afrikaans: "Goedgekeur, maar slegs waneer ons gereed is."
46. Albright, D. "How South Africa Abandoned Nuclear Weapons," unpublished draft article dated 3 November 1995, p. 12.
47. Minty, A. S. op.cit., p. 166.

48. Viljoen, J. Chronology of Events During the South African Nuclear Weapon Program, unpublished and undated document, p. 2.
49. Van der Westhuizen, L.J. and Le Roux, J.H. op.cit., pp. 174 - 175.
50. Viljoen, J. op.cit., p. 2.
51. Van der Westhuizen, L.J. and Le Roux, J.H. op.cit., pp. 174 - 175.
52. Albright, D. op.cit., 1995, p. 13.
53. Van der Westhuizen, L.J. and Le Roux, J.H. op.cit., p. 178.
54. International Atomic Energy Agency, op.cit., p. 6.
55. Von Baeckmann, A., Dillon, G. and Perricos, D. Nuclear Verification in South Africa, IAEA, <http://.iaea.or.at/worldatom/inforesource/bulletin/bull371/baeckmann.html>. (11 May 1999)
56. Albright, D. op.cit., July/August 1994, p. 10.
57. Reiss, M. op.cit., p. 11.
58. International Atomic Energy Agency, op.cit., p. 6.
59. Viljoen, J. and Smith, D. "The Birth, Life and Death of South Africa's Nuclear Weapon Progra,," article prepared for the Institute for Science and International Security, Washington D.C., 1999, p. 6.
60. Von Baeckmann, A., Dillon, G. and Perricos, D. op.cit., and interview with a former Advena employee on 17 May 2000.
61. Stumpf, W. op.cit.
62. Liberman, P. op.cit., p. 56 and Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
63. Buys, A. op.cit., pp. 5 - 6 and Reiss, M. op.cit., p. 15.
64. Albright, D. op.cit., 1994, p. 10.
65. Von Baeckmann, A., Dillon, G. and Perricos, D. op.cit.
66. Sublette, C. "Nuclear Weapons Frequently Asked Questions," <http://www.fas.org/nuke/hew/Nwfaq/Nfaq7.html>. (25 January 1999)
67. Albright, D. op.cit., 1994, p. 13.
68. Stumpf, W. op.cit.

69. Viljoen, J. and Smith, D. op.cit, p. 6.
70. Von Baeckmann, A., Dillon, G. and Perricos, D. op.cit.
71. Viljoen, J. and Smith, D. op.cit, p. 7.
72. Buys, A. "South Africa's Nuclear Weapons Capability," Salvo, 2/93, 1993, p. 18.
73. Stumpf, W. op.cit.
74. SABC, Special Assignment, Programme on the South African Nuclear Industry, SABC- 3, 16 March 1999.
75. Lockwood, D. and Wolfsthal, J.B. "Nuclear Weapon Development and Proliferation," in Stockholm International Peace Research Institute SIPRI Yearbook 1993: World Armaments and Disarmament, Oxford University Press, 1993, p. 253. According to Maj-Genl Mohammed Reda Fuda the HEU South Africa enriched was enough for producing 23 nuclear devices. Fuda, M.R. "The Nuclear Capability of South Africa," Defence Journal (Egypt), Vol. 105, April 1995, p. 5, (Translated from Arabic).
76. Albright, D., Berkhout, F. and Walker, W. Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies, SIPRI, Oxford University Press, 1997, p. 380.
77. Ibid, p. 369.
78. Stumpf, W. op.cit.
79. Interview with Deon Smith on 13 August 2001 in Pretoria.
80. AS:Minutes Archives Group, file 1/7/1/142, Memorandum No. 18 re Project Mantel, dated 2 October 1990, p. 1 as quoted in Van der Westhuizen, L.J. and Le Roux, J.H. op.cit, p. 181.
81. Albright, D. op.cit, 1994, p. 16.
82. Von Baeckmann, A., Dillon, G. and Perricos, D. op.cit.
83. Lockwood, D. and Wolfsthal, J.B. op.cit, p. 253.
84. Stumpf, W. "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," Arms Control Today, December 1995/January 1996, p. 7.
85. Viljoen, J. and Smith, D. op.cit, p. 10.
86. Albright, D. op.cit, p. 2.
87. Albright, D., Berkhout, F. and Walker, W. op.cit , p. 381.
88. International Atomic Energy Agency, op.cit, p. 8.

89. Ibid, pp. 10 - 11.
90. Albright, D., Berkhout, F. and Walker, W. op.cit, p. 378.
91. Wisconsin Project on Nuclear Arms Control, "South Africa Gives Up Nukes and Missiles; Now Gets High-Tech Imports," Risk Report Vol. 2, No.1, January/February 1996, p. 1, CD-ROM dated May/June 1998.
92. Department of Foreign Affairs, South Africa's Policy on the Non-Proliferation of Weapons of Mass Destruction, South African Communications Service, Cape Town, 1995, p. 8.
93. Department of Foreign Affairs, South Africa's Position on Matters Nuclear, Unpublished Document, July 1995, p. 2.
94. Department of Foreign Affairs, op.cit, 1995, pp. 7 - 8.
95. Department of Foreign Affairs, Non-Proliferation and Disarmament of Weapons of Mass Destruction: A South African Perspective, Unpublished Document, June 1997, p. 3.
96. Nzo, A. "Weapons that do not Respect Borders: South Africa has a Proud Record of Opposition to Nuclear Proliferation," Pretoria News, 21 May 1998.
97. SAPA Report, "Background on Role and Activities of the IAEA," 9 April 2001.
98. Minty, A. "The South African concept on Nukes," Mail and Guardian, 23 June 1995, <http://www.mweblibrary.com/nxt/gateway.dll/> (27 May 2002).
99. Department of Foreign Affairs, op.cit, 1995, p. 10.
100. Rajghatta, C. "New Resurgent South Africa soothes NPT Wounds," Indian Express, 11 May 1995.
101. Westdal, C. "The Nuclear Non-Proliferation Treaty (NPT) Review and Extension Conference: A Canadian Perspective", Presentation to the Standing Committee on Foreign Affairs and International Trade, House of Commons of Canada, 35th Parliament, 1st Session, 20 June 1995, Canadian Disarmament Digest, 10 April 1996, <http://www.dfait-maeci.gc.ca/english/foreignp/disarm/westall.htm> (8 January 1997).
102. Crossette, B. "Five Nuclear Powers Agree on Stronger Pledge to Scrap Arsenal," New York Times, 22 May 2000. South Africa's role within the New Agenda Coalition (NAC) at the 2000 NPT Review Conference is also described in Shelton, G. "South Africa's Nuclear Diplomacy: A Model for Cross-Strait Relations?" in Edmonds, M., Lee, C. and Mills, G. (Eds) New Security Paradigms, South African Institute of International Affairs, Johannesburg, 2001, pp. 171 - 175.
103. See the description of the relevance of the national prerequisites in Chapter 3.

104. Department of Energy, Fundamentals of Nuclear Energy and Nuclear Weapons Proliferation: Student Handbook, undated, p. 17.
105. See aims of the programme on page 14 of this Chapter.
106. Interview with official, who was involved in the programme but requested anonymity on 17 March 2000.
107. See the history of the programme, especially page 8 and 9 of this Chapter.
108. See for example International Atomic Energy Agency, op.cit, and Buys, op.cit, 1993, p. 18.
109. Liberman, P. op.cit, p. 63.
110. A “well-placed” source quoted by Hibbs, M. “South Africa’s Nuclear Program: From a PNE to Deterrent,” Nuclear Fuel, 10 May 1993, p. 5.
111. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
112. Newby-Fraser, A.R. op.cit, p. 36.
113. Ibid, p. 36.
114. Ibid, p. 38.
115. Interview with Dr Johann Viljoen on 25 May 2000 in Pretoria.
116. Long, W.J. and Grillot, S.R. “Ideas, Beliefs, and Nuclear Policies: The Cases of South Africa and Ukraine,” The Nonproliferation Review, Vol.7, No.1, Spring 2000, p. 25.
117. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
118. Interview with Dr Johann Viljoen on 25 May 2000 in Pretoria.
119. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
120. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
121. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
122. In interviews with Laurence “Louw” Alberts (AEB Vice President from 1971 to 1977) and Piet Koornhof (Minister of Minerals and Energy from 1972 to 1976) by Peter Liberman the role of the scientist during this period, Alberts recalls the 1960s and 1970s as “golden years” in which the “priest with the white coat had more impact than the priest with the black coat.” Koornhof recalls that it would have been unthinkable for him and other politicians to question the scientists’ advice on technical matters. Liberman, P. op.cit, p. 65.
123. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.

124. Interview with Dr Johann Viljoen on 25 May 2000 in Pretoria.
125. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
126. See Buys, A. op.cit, p.1.
127. Horton, R.E. op.cit, p. 5.
128. Mentioned by A Buys, J Viljoen and N Von Wielligh in interviews.
129. Barrie, G. op.cit, p. 153.
130. Long, W.J. and Grillot, S.R. op.cit, p. 28.
131. Gann, L.H. and Duignan, P. South Africa: War, Revolution or Peace? Hoover Institution Press, Stanford University, Stanford, 1978, p. 40.
132. Barrie, op.cit, p. 154.
133. Potter, W.C. Nuclear Power and Nonproliferation: An Interdisciplinary Perspective, Oelgeschlager, Gunn and Hain, Cambridge (Mass.), 1982, p. 143.
134. The Nonproliferation Centre, The Continuing Threat from Weapons of Mass Destruction, Washington D.C., March 1996, p. 2.
135. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
136. Adelman, K.L. and Knight, A.K. Impact upon US Security of a South African Nuclear Weapon Capability, Strategic Studies Center, Washington DC, 1981, p. 10.
137. See Frankel, P.H. Pretoria's Praetorians: Civil - Military Relations in South Africa, Cambridge University Press, Cambridge, 1984.
138. Grundy, K.W. The Militarization of South African Politics, IB Tauris and Company, London, 1986, p. 5.
139. Swilling, M. and Phillips, M. "State Power in the 1980s: From Total Strategy to "Counter-Revolutionary Warfare," in Cock, J. and Nathan, L. (Eds) War and Society: The Militarisation of South Africa, David Philip, Cape Town, 1989, p. 135.
140. The appointment of Dr Lukas Daniel Barnard as head of the Department of National Security (DONS) later National Intelligence Service (NIS) seems to indicate that his views on international affairs as well as nuclear strategy on which he wrote extensively before this appointment were widely shared within the then government
141. Grundy, K.W. op.cit, p. 5.

142. Director of Central Intelligence, "The 22 September 1979 Event," Interagency Intelligence Memorandum, December 1979, declassified version obtained through the Freedom of Information Act and released on 10 July 1990 as quoted in Albright, D. op.cit, 1995, p. 12.
143. Barnard studied nuclear strategy in the US in 1979. Pretoria News, 19 June 2002.
144. Barnard, L.D. "The Proliferation of Nuclear Weapons and International Order," undated unpublished article, p. 14.
145. Barnard, L.D. "Deterrent Strategy for Nuclear Weapons," undated unpublished article, p. 8.
146. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
147. Mentioned by all persons interviewed as a major incentive for the nuclear weapon capability.
148. Louw, M.H.H. "General Conclusion," in Louw, M.H.H. (Ed) National Security: A Modern Approach, Institute for Strategic Studies, University of Pretoria, Pretoria, 1978, p. 198.
149. Albright, D. op.cit 1995, p. 8.
150. Crocker, C. High Noon in Southern Africa, W.W. Norton and Company, New York, 1992, p. 50.
151. Pabian, F.V. op.cit, p. 3.
152. Louw, M.H.H. op.cit, p. 198.
153. National Security Council, El-Khawas M.A. and Cohen, B. (Eds) The Kissinger Study of Southern Africa: National Security Study Memorandum 39, Lawrence Hill, Westport, 1976, p. 81.
154. Adelman, K.L. and Knight, A.K. op.cit, p. 24.
155. Gann, L.H. and Duignan, P. Why South Africa will Survive, Tafelberg, Cape Town, 1981, pp. 164 - 168.
156. Johnson, R.W. How Long will South Africa Survive? MacMillan Press, London, 1977, p. 211.
157. During a lecture to the Joint Staff Course 1977 at the SA Defence College by Lt. Genl Constand Viljoen (later chief of the SADF) on the role of the military in South Africa he stated that the West was "pathetic". According to him the USA was paralysed because of the black vote and the Vietnam experience. The UK was described as "weak" and France inhibited by the strength of its Communist Party. The West is diplomatically orientated and did not have the cohesion to "fight" against the Eastern Block according to him. Viljoen, C. "Die Rol van die Militêr in die RSA," notes taken by Roux, H., Joint Staff Course 1977, Dossier Strategy, Vol. 4, Precis 3.

158. McCGwire, M. "The Paradigm that Lost its Way," International Affairs, Vol. 77, No. 4, October 2001, p. 779.
159. Gann, L.H. and Duignan, P. op.cit, p. 24.
160. Hansard 1980, vol 86, col. 5294.
161. Department of Defence, White Paper on Defence and Armaments Supply, 1982.
162. Liberman, P. op.cit, p. 85.
163. Barrie, G. op.cit, pp. 152 - 153.
164. Swilling, M. and Phillips, M.. op.cit, p. 135.
165. See for example Lass, H.R. "Die Totale Bedreiging teen Suid-Afrika," unpublished presentation delivered at the SABRA Youth Congress at Middelburg, 20 July 1977 and Liebenberg, P.W. "Die Internasionale Posisie en Buitelandse Beleid van die Republiek van Suid-Afrika," Joint Staff Course 1977, Dossier Strategy, Vol. 6, Precis 3.
166. General Magnus Malan as quoted in Grundy K.W. op.cit, p. 11.
167. SA Defence College, "The Direct Mode of Total Strategy," (Sourced from a lecture by Cmdt D.F.S. Fourie, Department of Political Science UNISA), Joint Staff Course 1977, Dossier Strategy, Vol. 2, Precis 7.
168. Liberman, P. op.cit, p. 67 and interview with Prof Andre Buys on 7 June 2000 in Pretoria.
169. Ibid, p. 66.
170. General Magnus Malan the then SADF Chief stated that he was not involved in the Voster's "... decision to acquire a deterrent." Ibid, p. 65.
171. Interview with Prof Andre Buys on 7 June 2000 in Pretoria.
172. Liberman, P. op.cit, p. 72.
173. Stumpf, W. op.cit.
174. Shelton, G. "South Africa and the Nuclear Non-Proliferation Treaty (NPT): Bridging the North - South Divide on Nuclear Weapons," Presentation given at the "Workshop on the Non-Proliferation Treaty (NPT),"organised by the Konrad Adenauer Foundation, Department of International Relations (University of the Witwatersrand) and the South African Institute of International Affairs (SAIIA) held in Johannesburg, 29 March 2000 and Interview with official, who was involved in the programme but requested anonymity on 17 March 2000.
175. US Library of Congress, "South Africa: Nuclear, Chemical, and Biological Weapons," Document dated May 2002 ,

[http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+za0136\)](http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+za0136)) (17 July 2002).

176. Interview with Deon Smith on 13 August 2001 in Pretoria.
177. Ibid.
178. Ibid.
179. During an interview with General Jannie Geldenhuys (the then SADF Chief) conducted by Peter Liberman, Geldenhuys states that he never saw any military utility in the nuclear arsenal and was also not consulted in the decision to dismantle the capability. Liberman, P. op.cit., p. 78.
180. Interview with Prof Andre Buys on 7 June 2000 in Pretoria. See also Liberman, P. op.cit., p. 78.
181. Rosenthal, R. Mission Improbable: A Piece of the South African Story, David Philips Publishers, Cape Town, 1998, p. 203.
182. International Institute for Strategic Studies, Strategic Survey: 1988 - 1989, Brassey's, London, 1989, p. 204.
183. US Library of Congress, op.cit.
184. International Institute for Strategic Studies, Strategic Survey: 1989 - 1990, Brassey's, London, 1990, p. 15.
185. De Klerk, F.W. op.cit., pp. 291 - 292.
186. Buys, A. op.cit., 1993, p. 18.
187. The Argus, "How South Africa's Nuclear Secrets were Unveiled: FW De Klerk's Speech; The Full Text," 25 March 1993.
188. De Klerk, F.W. op.cit., p. 292.
189. Stumpf, W. op.cit.
190. See for example the study on the cost of the US nuclear weapon programme done by the Brookings Institution. Schwartz, S. I. (Ed), Atomic Audit: The Cost and Consequences of the US Nuclear Weapons since 1940, Brookings Institution Press, Washington D.C., 1998.
191. Interview with Dr Johann Viljoen on 25 May 2000 in Pretoria.
192. De Klerk, F.W. op.cit., p. 291.
193. See the description of the termination of the nuclear weapon capability earlier.

194. See the view of J.H. Cunningham that top United States strategic policy planners declare that South Africa remains a member of the international nuclear club because it still has the technical know-how to build a nuclear bomb as reported by Chandler, N. "South Africa still seen as a Member of Nuclear Club," The Star, 19 December 1996. Also see South Africa Report, "US warns that South Africa's Nuclear Expertise is tempting for other Countries," Washington D.C., 3 December 1997.